REMARKS

Original claims 1-99 are pending in the application.

Rejections Under 35 U.S.C. §103(a)

Reconsideration is requested of the rejection of claims 1-22, 26-28, 33-78, 82-87, 89, and 91-99 under 35 U.S.C. §103(a) as obvious in view of the disclosure in U.S. Publication No. 2001/0003672 A1 (Inoue et al.). Applicants respectfully submit these claims are patentable over the disclosure of Inoue et al. for the reasons set forth in applicants' Letters filed February 13, 2006 and May 11, 2006, and for the following reasons.

In order to establish a *prima facie* case of obviousness, the Patent Office must establish, *inter alia*, that there is some suggestion or motivation to modify the reference and that the reference teaches or suggests all the claim limitations (See MPEP §2143). Applicants submit that the office has failed to meet its burden with respect to establishing a *prima facie* case of obviousness.

Claim 1

Claim 1 is directed to an etching process for removing silicon from the surface of a silicon wafer that requires, *inter alia*, contacting the surface of the wafer with a caustic etchant in which the concentration of water is less than 45% by weight.

Inoue et al. do not disclose or attribute any significance to the concentration of water in the disclosed polishing composition, much less teach that it should be maintained below 45% by weight as called for in claim 1, and nothing in the reference would teach or suggest one skilled in the art to do so. As the basis of the rejection, the Office attempts to

indirectly establish motivation or suggestion to arrive at this claim limitation by referring to disclosure in Inoue et al. regarding the concentration of other components of the polishing composition (i.e., abrasive and alkali metal hydroxide additive) and, by subtraction, use this disclosure to determine water content.

The Office continues to misconstrue the disclosure in Inoue et al.

As previously acknowledged by applicants, Inoue et al. disclose polishing compositions comprising water, an abrasive and one or more various candidate additives, including an alkali metal hydroxide, in which the concentration of alkali metal hydroxide in the polishing solution can vary from 0.001 to 30 wt% (See paragraph [0030]) and the concentration of abrasive can **independently** vary from 0.01 to 50 wt% (See paragraph [0049]).

The Office points to only selected portions of the disclosure of Inoue et al. in paragraphs [0032] and [0049] in an attempt to establish that the cited reference suggests and would motivate one skilled in the art to use concentrations of alkali metal hydroxide **and** abrasive at the higher end of the broadest disclosed ranges for these two components in order to increase the polishing rate of the wafer. However, the Office has ignored relevant portions of the disclosure in Inoue et al. and thereby misconstrued the teaching of the reference.

With respect to concentration of the various disclosed additives such as an alkali metal hydroxide, Inoue et al. disclose in paragraph [0032]:

> "When such an additive is used for a polishing composition, there is a tendency that as the amount increases, the polishing removal rate becomes high, and

> when it is used repeatedly by recycling, decrease of the polishing removal rate becomes small. **However, if the amount is excessively large, the chemical action as a polishing composition tends to be too strong, whereby a surface defect such as surface roughening of the wafer surface due to a strong etching action, is likely to result, or the dispersion stability of abrasive grains is likely to be lost, whereby precipitates may form.** On the other hand, if the amount is too small, the polishing removal rate tends to be low, and it takes a long time for polishing operation, whereby the productivity decreases, such being not practical. Especially when fumed silica is used as the abrasive, gelation is likely to take place in the polishing composition, and the dispersion stability tends to be poor, and the viscosity of the composition tends to be so high that the handling will be difficult." (emphasis added)

With respect to concentration of an abrasive, Inoue et al. disclose in paragraph [0049]:

> "The content of the abrasive in the polishing composition is usually from 0.01 to 50 wt %, preferably from 0.05 to 30 wt %, more preferably from 0.1 to 20 wt %, based on the total amount of the composition. If the content of the abrasive is too small, the polishing removal rare [*Sic*] will be low, and it will take a long time for processing, whereby the productivity will be too low to be practical. **On the other hand, if it is too large, uniform dispersion tends to be hardly maintained, and the viscosity of the composition tends to be excessive, whereby the handling tends to be difficult.**" (emphasis added)

Thus, contrary to the assertion in the Office action, the cited disclosure in paragraphs [0032] and [0049] of Inoue et al. does not suggest combining a high concentration of alkali metal hydroxide **and** a high concentration of abrasive to achieve a high polishing rate, but rather admonishes that the concentration of these components must be independently moderated in a polishing composition in order to avoid various adverse effects (i.e.,

formation of surface defects and roughness and loss of abrasive grain dispersion stability in the case of too high additive (alkali metal hydroxide) concentration and loss of dispersion uniformity and excessive viscosity in the case of too high abrasive concentration). These concerns are certainly important in the polishing compositions taught by Inoue et al., but are not implicated in the claimed etching process, which typically is followed by a separate polishing operation.

Consistent with this teaching, Inoue et al. disclose narrower and much lower preferred ranges for the concentration of alkali metal hydroxide and abrasive in paragraphs [0030] and [0049], respectively. Specifically, in paragraph [0030], Inoue et al. disclose that when the additive is an alkali metal hydroxide it is more preferably present at a concentration of from 0.01 to **5 wt%** and most preferably from 0.05 to **3 wt%**, and in paragraph [0049] Inoue et al. disclose that the abrasive content is preferably from 0.05 to **30 wt%** and most preferably from 0.1 to **20 wt%**. Applicants do not contend that the disclosure in Inoue et al. is limited to the preferred embodiments, but for purposes of assessing obviousness and motivation or suggestion to modify a reference, the entire disclosure is relevant and the Office must consider all that a reference teaches including portions that lead away from the claimed invention (See MPEP 2141.02).

The Office has also ignored the specific teaching regarding alkali metal hydroxide and abrasive content of the polishing compositions prepared and used in the working examples of Inoue et al. and the reported effectiveness of these compositions. As noted in applicants' Letter filed May 11, 2006, **all** of the polishing compositions in the working examples that include a

source of hydroxide ions (See Examples 1-6, 9-13, and 16-30 described in Tables 1 and 2) include water at concentrations greatly in excess of 45% by weight (e.g., approximately 94% by weight or greater). Thus, the working examples describe alkali metal hydroxide and abrasive component concentrations at or near the lower end of the broadest disclosed range and consistent with the preferred ranges disclosed in paragraphs [0030] and [0049]. Based on the results reported in Tables 1 and 2, Inoue et al. conclude that the polishing compositions described in the working examples provide **a high polishing removal rate** and "a very smooth polished surface with little formation of dopant striation" (See paragraphs [0082] and [0096]).

Thus, regardless of the general observation that polishing removal rate tends to increase with increasing content of alkali metal hydroxide and abrasive, one skilled in the art would hardly be motivated to move to the extreme upper end of **both** of the broadest disclosed ranges for these two components to increase the polishing removal rate in view of (1) the above-noted disclosure in Inoue et al. that the concentration of alkali metal hydroxide and abrasive must be moderated in order to avoid adverse consequences in the polishing operation; and (2) the effective polishing compositions demonstrated in the working examples containing these components in proportions at or near the lower end of the broadest disclosed range and within the preferred ranges set forth in paragraphs [0030] and [0049] and which nevertheless **provide a high polishing removal rate,** while avoiding surface roughness and other adverse effects of too high alkali metal and/or abrasive content. In view of the entire disclosure of Inoue et al. and provided with the effective polishing compositions demonstrated in the working

examples capable of a high polishing removal rate, one skilled in the art would not have been motivated to risk the adverse consequences said to accompany a too high alkali metal hydroxide or abrasive content and increase the concentration of **both** of these two components to near the upper limits of the broadest disclosed ranges. In the absence of teaching or suggestion to incorporate both these components at the upper ends of the broadest disclosed ranges, a teaching or suggestion of a polishing composition in which the concentration of water is less than 45 wt% clearly cannot be attributed to the disclosure of Inoue et al.

Based on the foregoing, applicants respectfully submit that the process defined in claim 1 is patentable over the disclosure of Inoue et al. Likewise, applicants respectfully submit dependent claims 2-22 and 26-28 are patentable over the disclosure of Inoue et al. for the reasons set forth above concerning independent claim 1 and for the additional limitations present in these claims.

Claim 33

Claim 33 is directed to an etching process for removing silicon from the surface of a silicon wafer that requires, *inter alia*, contacting the surface of the silicon wafer with a caustic etchant in which the concentration of a source of hydroxide ions is greater than 55% by weight.

Applicants respectfully submit claims 33-62 remain patentable over the disclosure of Inoue et al. for the reasons set forth in applicants' Letter filed May 11, 2006, and for the following reasons.

A *prima facie* case of obviousness may be established if a claimed range is shown to be the result of optimization of a result-effective variable within the conditions described in the prior art or through routine experimentation (See MPEP 2144.05). Assuming only for purposes of this Letter that the disclosure of Inoue et al. establishes that the alkali metal hydroxide content of the polishing composition is a result-effective variable, applicants nevertheless submit that the disclosure of Inoue et al. fails to establish a *prima facie* case of obviousness as to claim 33.

The highest additive content that might be attributed to a source of hydroxide ions (e.g., alkali metal hydroxide or quaternary ammonium salt such as tetramethylammonium hydroxide) in the disclosure of Inoue et al. is in the broad range 0.01 to 50 wt% disclosed in paragraph [0029]. However, applicants note that the highest concentration specific to alkali metal hydroxide or quaternary ammonium hydroxide salt content is 0.01 to 30 wt% and 0.05 to 15 wt%, respectively, disclosed in paragraph [0030]. In any event, none of these ranges encompass a caustic etchant containing a source of hydroxide ions at a concentration of greater than 55% by weight as required in the process of claim 33. To attribute suggestion of a composition in which the concentration of a source of hydroxide ions is greater then 55% by weight to the specific disclosure of Inoue et al. of alkali metal hydroxide or quaternary ammonium hydroxide salt content of from 0.01 to 30 wt%, or from 0.05 to 15 wt%, or even the general disclosure of additive content of from 0.01 to 50 wt%, requires "optimization" of this variable to a point outside of the disclosed range. Applicants respectfully submit such an exercise does not involve optimization of a

result-effective variable that may properly be relied on to establish a *prima facie* case of obviousness but, rather, involves unsupported extrapolation to a point outside the disclosure of the cited reference.

This is particularly the case when considered in view of the entire disclosure of Inoue et al. As noted above, Inoue et al. teach in paragraph [0032] that the concentration of additives such as alkali metal hydroxide or quaternary ammonium hydroxide salt must be moderated in order to avoid adverse consequences (e.g., too strong etching action leading to surface roughening) in the polishing operation. Not surprisingly, the polishing compositions described in **all** the working examples of the cited reference that include a source of hydroxide ions (See Examples 1-6, 9-13, and 16-30 described in Tables 1 and 2) contain a source of hydroxide ions at a concentration of no greater than about 4% by weight, near the lower end of the broadest disclosed range and within the preferred ranges set forth in paragraph [0030]. These compositions are described as **providing a high polishing removal rate** and a very smooth polished surface (i.e., free of surface roughness).

Applicants respectfully submit Inoue et al. as a whole clearly teaches away from increasing the concentration of a source of hydroxide ions in the polishing composition to greater than 55% by weight as called for in claim 33. Contrary to the assertion in the Office action, one skilled in the art seeking to attain a high polishing removal rate would not "optimize" the concentration of a source of hydroxide ions in the composition of Inoue et al. to a point fully outside the disclosed range. The working examples of the reference demonstrate that a high polishing removal rate is readily attained at much lower

concentrations of the hydroxide source while avoiding surface roughening (the very purpose of a polishing operation) that occurs if the additive concentration is too high. Preparation of compositions containing a component at concentrations outside the ranges disclosed by Inoue et al. and implicating the adverse consequences that would result as taught by the reference cannot be construed as "routine experimentation." Only through impermissible hindsight in view of applicants' disclosure would one skilled in the art be motivated to prepare such compositions.

Based on the foregoing, applicants respectfully submit the disclosure of Inoue et al. fails to establish a *prima facie* case of obviousness as to claim 33 and the claimed invention remains patentable as previously indicated by the Office. Likewise, dependent claims 34-62 remain patentable over the disclosure of Inoue et al. for the reasons set forth above concerning independent claim 33 and for the additional limitations present in these claims.

Claim 63

Claim 63 is directed to an etching process for removing silicon from the surface of a silicon wafer and requires, *inter alia*, contacting the surface of the wafer with a caustic etchant in which the concentration of the source of hydroxide ions is at least about 70% of the saturation concentration of the source of hydroxide ions in the caustic etchant.

As noted in applicants' May 11, 2006 Letter, the saturation concentration of an alkali metal hydroxide is temperature dependent. The disclosure of Inoue et al., including the working examples, does not include the temperature of the

polishing composition and the polishing temperature is not one of the conditions provided for the polishing tests described in the working examples. Thus, the exemplified alkali metal hydroxide and quaternary ammonium hydroxide salt concentrations of the working examples of Inoue et al. cannot be expressed in terms of a proportion or percent of the saturation concentration.

But even if the disclosure of Inoue et al. included sufficient information for calculating the saturation concentration of the source of hydroxide ions in the polishing composition, the disclosure of Inoue et al. would not motivate one skilled in the art to consider maintaining the concentration of the source of hydroxide ions at at least 70% of the saturation concentration as required in claim 63. As detailed above, the working examples of Inoue et al. demonstrate suitable polishing compositions that include a source of hydroxide ions (alkali metal hydroxide or quaternary ammonium hydroxide salt additives) at a concentration of no greater than about 4% by weight and capable of attaining **a high polishing removal rate**, while avoiding surface roughness said to occur when the additive concentration is too high. Thus, the disclosure of Inoue et al. provides no teaching or suggestion of increasing the concentration of the source of hydroxide ions in the polishing composition to an extent such that it is at least 70% of the saturation concentration.

In view of the above, applicants respectfully submit the process of independent claim 63 and dependent claims 64-78 remains patentable over the disclosure of Inoue et al. as previously indicated by the Office.

Claims 82 and 99

The etching processes of independent claims 82 and 99 utilize a caustic etchant comprising water, hydroxide ions and a salt additive. In the process of claim 82, the salt additive comprises a compound selected from the group consisting of inorganic alkali and alkaline earth metal salts and mixtures thereof and the concentration of the salt additive in the caustic etchant is at least about 4 mole percent. In the process of claim 99, the salt additive comprises a compound selected from the group consisting of potassium carbonate and potassium fluoride and the concentration of the salt additive in the caustic etchant is at least about 1 mole percent.

As acknowledged in applicants' May 11, 2006 Letter, the list of six candidate additives disclosed in Inoue et al. includes both alkali metal carbonate salts (such as potassium carbonate and sodium carbonate) and hydroxide ion sources (such as alkali metal hydroxide and quaternary ammonium hydroxide salt) (See paragraphs [0015] and [0022] to [0028]) and that the cited reference teaches generally that these additives may be used in combination (See paragraph [0029]). However, the remainder of the disclosure in Inoue et al. does not contemplate the use of more than one of the additives in the disclosed compositions. Moreover, the reference fails to teach or suggest **any** specific combinations of the six optional additives, much less the combination of a source of hydroxide ions and a salt additive as called for in claims 82 and 99. Among the myriad possible combinations of the six different types of optional additives alluded to generally by Inoue et al. (including numerous combinations that would not contain a source of hydroxide ions and/or an alkali metal carbonate), the cited

reference fails to teach or suggest the specific combination of a hydroxide ion source additive with an alkali metal carbonate additive in accordance with the process of claims 82 and 99. None of the polishing compositions described in the 30 Examples of Inoue et al. include the combination of a hydroxide ion source additive with an inorganic alkali or alkaline earth metal salt. In the two Examples that include potassium carbonate as an additive in the polishing composition (Examples 7 and 8), the polishing composition does not include hydroxide ions or, for that matter, any of the other additives disclosed by Inoue et al. **To the extent that the Office maintains that the disclosure of Inoue et al. teaches or suggests the specific combination of a source of hydroxide ions and a salt additive as called for in claims 82 and 99, applicants respectfully challenge the Office to cite such disclosure by reference to a specific paragraph of the reference.**

In addition to providing no teaching or suggestion that would motivate one skilled in the art to select the specific combination of an alkali metal carbonate and hydroxide ion source form the list of candidate additives, Inoue et al. fail to teach or suggest making such a combination in a composition with an abrasive (i.e., in a polishing composition), other optional additives and water in such proportions so as to obtain a caustic etchant containing the minimum salt additive content recited in claim 82 (at least about 4 mole percent of the inorganic alkali metal salt) or claim 99 (at least about 1 mole percent of potassium carbonate).

In an attempt to overcome this deficiency in paragraphs 84 and 103 of the Office action, the Office inexplicably attributes to the disclosure of Inoue et al. a composition containing 30

wt% sodium hydroxide, 20 wt% potassium carbonate and 50 wt% water. **Applicants respectfully challenge the Office to cite by reference to a specific paragraph(s) of Inoue et al. the basis for the assertion that the reference suggests first, a composition containing both sodium hydroxide and potassium carbonate; and second, that the sodium hydroxide and potassium carbonate be present in the proportions set forth in paragraphs 84 and 103 of the Office action.** Applicants respectfully maintain that the cited reference in fact contains no such teaching or suggestion whatsoever.

In view of the foregoing, independent claims 82 and 99 are submitted as patentable over the disclosure of Inoue et al. Dependent claims 83-87, 89 and 91-98 are patentable over the disclosure of Inoue et al. for the reasons set forth above concerning claim 82 and for the additional limitations in these claims.

Claims 23-25, 29, and 79-81; Claims 30-32; Claim 88; and Claim 90

Reconsideration is requested of the rejection of dependent claims 23-25, 29, and 79-81 under 35 U.S.C §103(a) based on the disclosure of Inoue et al. in view of the disclosure of U.S. Patent No. 6,099,748 (Netsu et al.).

Reconsideration is also requested of the rejection of dependent claims 30-32 under 35 U.S.C §103(a) based on the disclosure of Inoue et al. in view of the disclosure of U.S. Patent No. 6,793,836 (Tsung-Kuei et al.).

Reconsideration is also requested of the rejection of dependent claim 88 under 35 U.S.C §103(a) based on the disclosure of Inoue et al. in view of the disclosure of U.S.

Patent No. 5,769,691 (Fruitman et al.) and further in view of Wolf, *Silicon Processing for the VLSI Era*, Vol. 4, Lattice Press (2002).

Reconsideration is also requested of the rejection of dependent claim 90 under 35 U.S.C §103(a) based on the disclosure of Inoue et al. in view of the disclosure of Fruitman et al. and further in view of U.S. Patent No. 6,361,403 (Kuramochi et al.).

Applicants respectfully submit that these proposed combinations of references fail to establish a *prima facie* case of obviousness with respect to the subject matter of these dependent claims for the reasons set forth above concerning the deficiencies of the disclosure in the primary reference, Inoue et al., with respect to the independent claim from which they depend and for the additional limitations set forth in these claims.

Favorable reconsideration and allowance of all pending claims are again respectfully solicited. Applicants do not believe any fees are due with the timely submission of this Letter. However, the Commissioner is requested to charge any fee deficiency in connection with this Letter to Deposit Account No. 19-1345.

Respectfully submitted,

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